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(56) Documents cited  
GB 1365496 A GB 1335941 A EP 0023168 A  
SU 001535637 A SU 001274769 A US 4767511 A  
US 4212714 A

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INT CL<sup>1</sup> C02F, C25B  
Online databases: WPI, CHEMICAL ABSTRACTS

(54) Electrolytic treatment of water

(57) Water flows under pressure in chamber 3 (anode or cathode) of a diaphragm electrolyser, with simultaneous filtration of water into the opposing electrode chamber, and the water is forced upwards under pressure from rising gas bubbles to a tank 7 and re-enters into the same chamber 3 after gas has been separated in tank 7 and dispersed into the atmosphere. The diaphragm flow-electrolyser may be a closed flow-circuit which incorporates one of the electrode chambers, the tank 7 and a gas-separation valve. The diaphragm electrolyser may be in the form of a module (Fig. 2 not shown) with a coaxial tubular external electrode, an internal rod electrode, and a tubular zirconium oxide ultrafiltration diaphragm, all secured by means of packing rings and facing bushes which are a continuation of the outer surface of the tubular electrode.

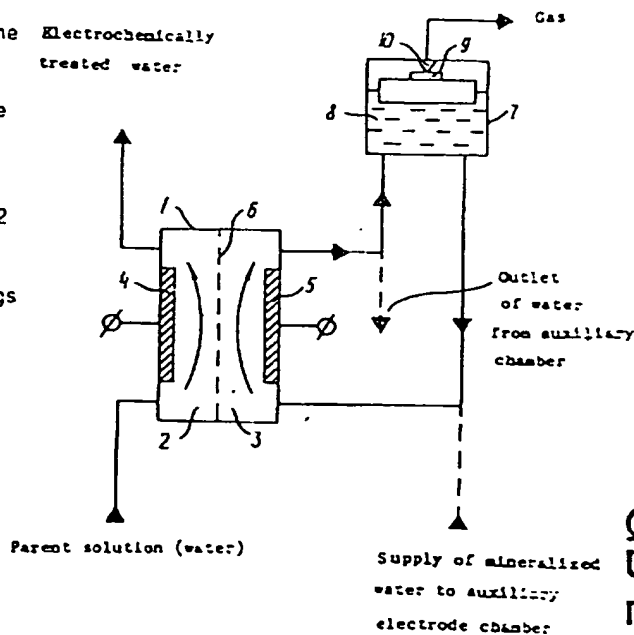


Fig. 1

Principle diagram showing the method of electrolytic treatment of water

GB 2 253 860 A

Following the decision of the Comptroller under Sections 13(1)&(3) dated 13 January 2000 Ronald Francis Kirk was deleted as inventor and Vitold Mikhailovich Bakhir was added as inventor.

This front page is a reprint to rectify errors introduced in the course of reproduction-07.07.2000

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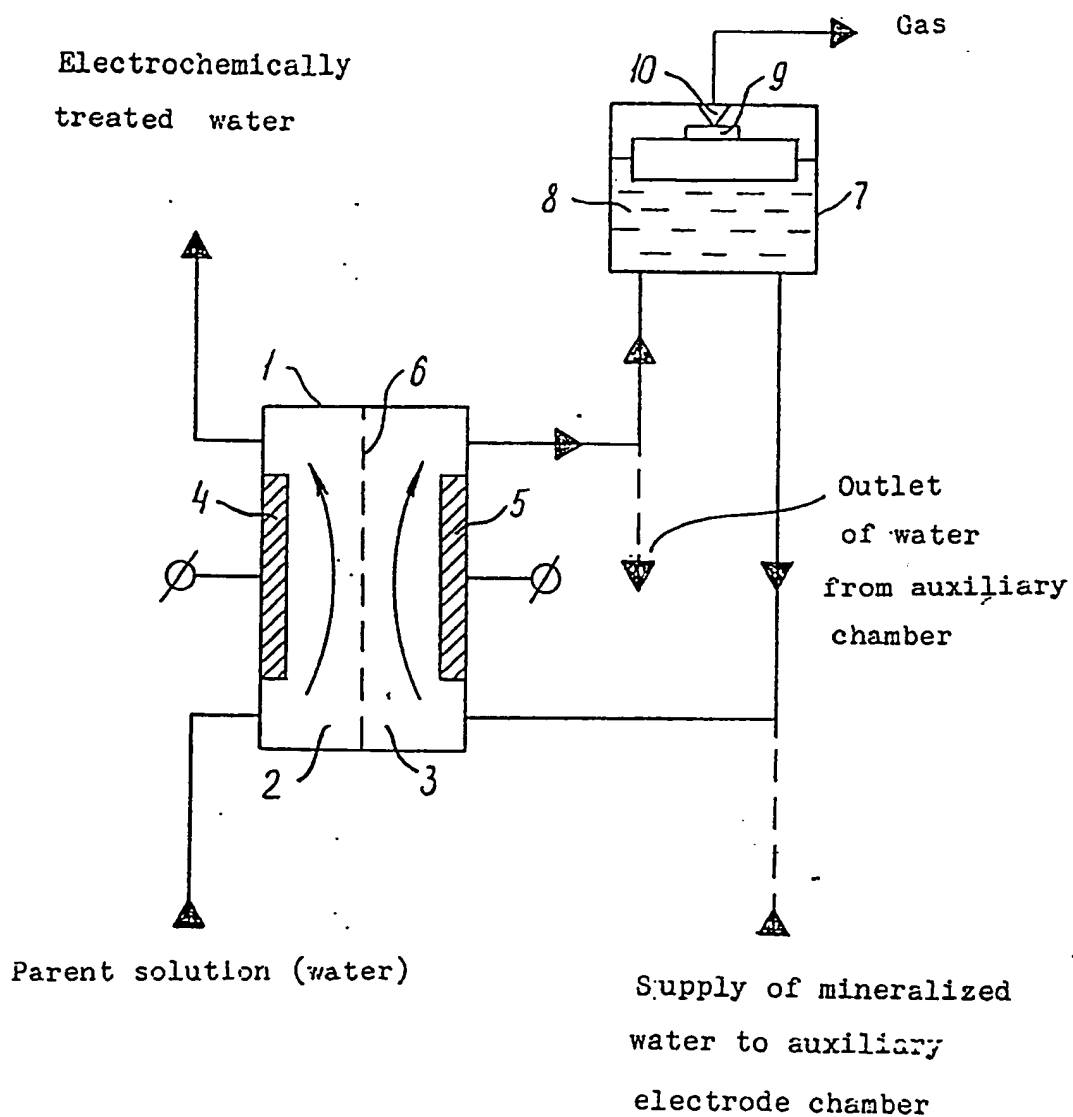


Fig.I

Principle diagram showing the method of electrolytic treatment of water

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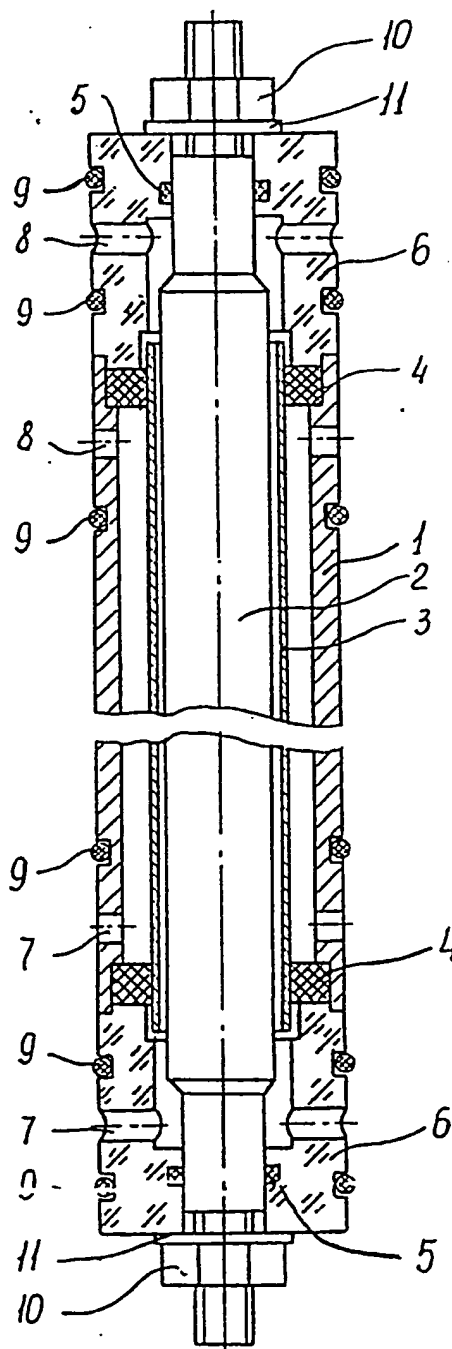


Fig.2

Diagram of membrane electrolyzer designed in the form of modular-type electrolytic element

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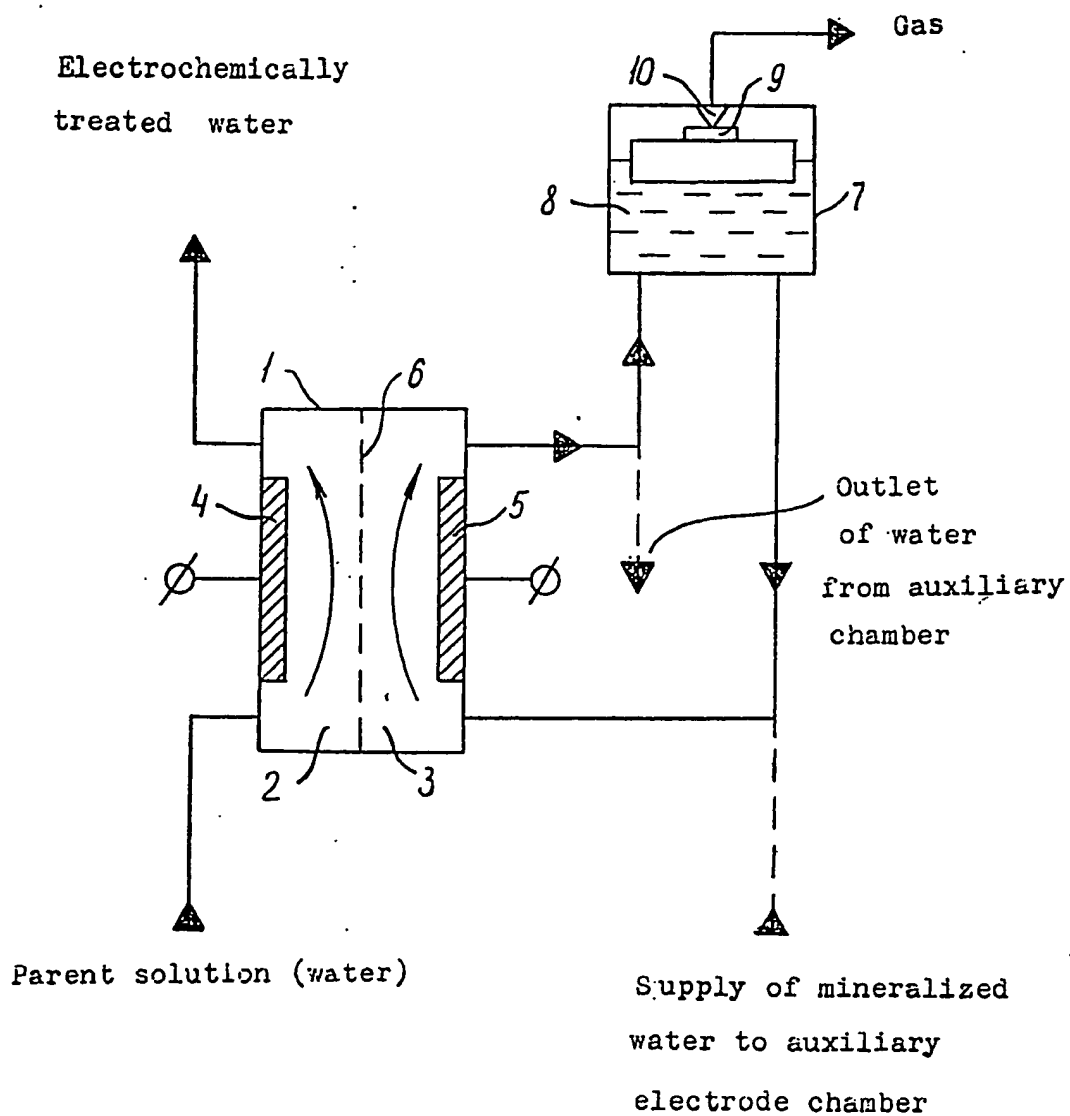


Fig.I

Principle diagram showing the method of electrolytic treatment of water

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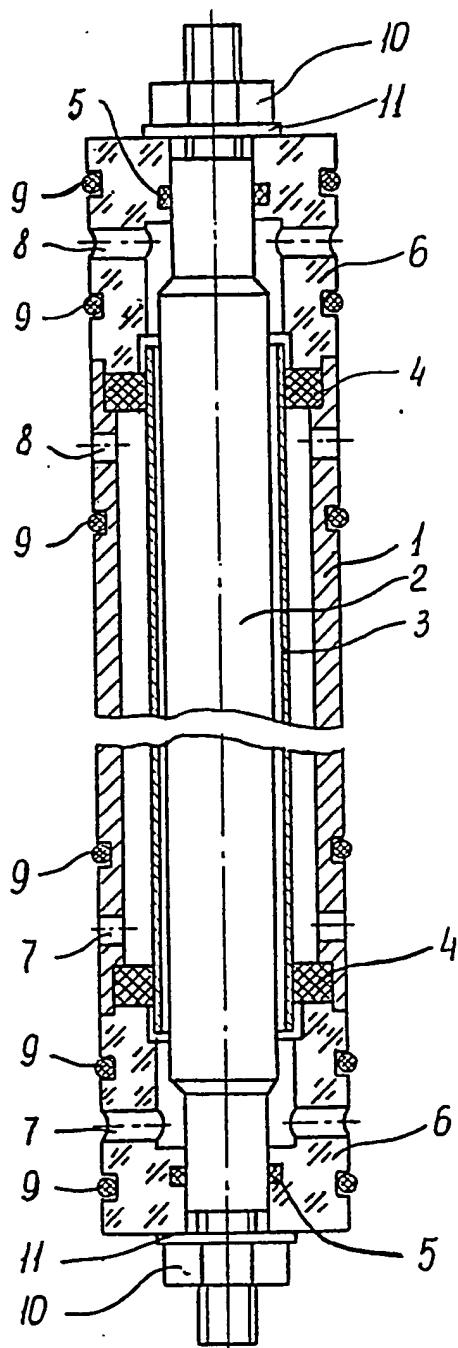


Fig. 2

Diagram of membrane electrolyzer designed in the form of modular-type electrolytic element

ELECTROCHEMICAL TREATMENT OF WATER AND A  
DEVICE FOR ELECTROCHEMICALLY TREATING WATER

Specifications

## ELECTROCHEMICAL TREATMENT OF WATER AND A DEVICE FOR ELECTROCHEMICALLY TREATING WATER.

This invention relates to the sphere of electrochemical treatment of water with the aim of directed change of water acid, alkali, oxidizing and reducing properties, as well as of catalytic activity of water in basic-acid and oxidizing-reducing reactions.

This invention shall be applied in the spheres, where the above-mentioned properties of water or water solutions are very important for production of final product of best quality.

For example, acid, alkali, oxidizing and reducing aqueous solutions, which are produced for different purposes of industry, shall be purified of alien solutes. But in accordance with physical laws, 100% purification is impossible. Thousands of tons of different substances are soluted in millions of tons of water every day all over the world to decrease hardness of water, to increase its detergency, to convert water into disinfectant or lubricant, to improve its solvent or wetting action, to decrease its reactivity to other substances, to impart water with antirust properties, to convert it into the media, good for crystallization or incubation and for many other purposes.

Saving of chemical reagents all over the world is nomally achieved with the aid of traditional fundamental methods, such as selection of the most favorable working temperature, pressure and catalyzer. The fourth fundamental process control technology is the addition to water and dissolving in it of other agents.

Not so long ago the fifth fundamental technology was born.

It was named activation. Activation made it possible to control reactivity of water and aqueous solutions practically without changing of their chemical composition. One of the most effective methods of activation of water and aqueous solutions is their electro-chemical unipolar (anode or cathode) processing with the aid of membrane electro-chemical reaction vessel (device), which is called electro-chemical activation (ECHA). The advantage of ECHA over the well known magnetic, mechanic-chemical and baro-thermal treatment is obvious, because ECHA combines possibilities for formation of non-equilibrium high-reactive dissipative structures in water with electro-chemical synthesis of new chemically active compounds of water and agents, dissolved in it.

Term "activation", used herein, means temporary deviation of water (substance in general) properties from thermodynamic ballance values with the aid of external physical action with constant temperature and chemical element composition before and after external physical action.

Thermodynamically disballanced (metastable or activated) water, possesses excess internal potential energy, which is dipersed gradually or is consumed quikly during different physical-chemical reactions and determines its irregular activity.

The actions of chemical activation, which is described as recommendations in chemical handbooks is known.

In analytic chemistry many solutions after preparation shall be kept from several hours to several days before utilization to achieve preciseness of analysis. Stabilization of solution properties shall be achived during dispersion of



excess internal potential energy, accumulated in the solution in the form of structure excitation during the process of component dissipation.

During the process of electrolytic treatment changes the structure of water, which contacted the surface of electrode with field intensity of millions of volts per  $\text{cm}^2$ . Those changes practically do not affect pH and oxidizing-reducing potential, but affect complexing, catholytic, biocatholytic and other reactions.

It is very difficult to expose electrochemical activation structural factors influence on the background of high-active electrochemical activation products. And it is not necessary during electrochemical activation operating process, because both factors - chemical and activating - coincide in directions of influence on physical-chemical reactions and improve their effectiveness.

Unlike the traditional electrolysis, the aim of which is production of pure products of electrochemical reactions, electrochemical activation is provided to impart water (aqueous solutions) with necessary functional properties before utilization under conditions of constant initial mineralization grade.

Electrochemical activation process is accomplished with the aid of cathode or anode electrochemical water treatment in membrane electrochemical reaction vessel (device), which is designed as a modification of membrane electrolyzer.

As a result of cathode treatment, the water, which, as a rule, contains dozens of soluted agents, including distilled,

drinking and mineralizes water, acquires alkali reaction from the initial pH 7 to pH 7.5 - 12 ) thanks to conversion of part of dissolved salts to hydroxides. Water oxidizing-reducing potential decreases sharply (from initial +300 mV to -300... ... -800 mV in the scale of indicating platinum electrode with respect to silver-chloride electrode), surface tension and contents of dissolved oxygen, chlorine and nitrogen also decreases, while hydrogen and free hydroxyl groups concentration increases. Electroconductivity of water drops and the structure of not only hydrate ion coating, but of volume of liberated water changes.

Forming of well-soluble sodium and potassium hydroxides and increase of pH, provide the shift of carbonic acid balance and formation of difficultly soluble carbonates of potassium and magnesium of hydrocarbonates, chlorides and sulfates of these metals, dissolved in the initial water.

Heavy metal and iron ions precipitate almost completely in the form of non-soluble hydroxides. The reaction of sodium and potassium hydroxides with carbon dioxide, forms soluble carbonates and hydrocarbonates.

Cathode electro-chemical treatment of drinking water provides considerable decrease of its hardness and toxicity.

Water during and after cathode electro-chemical treatment is called catholyte.

As a result of anode electro-chemical treatment, water acidity increases from the initial pH 7 to pH 2-6, oxidizing-reducing potential increases from +300 mV to +400 - +1200 mV thanks to formation of stable and non-stable acids, such as

sulphuric, muriatic, hypochloric, chlorous, perchloric and persulfuric, and also hydrogen peroxide, peroxosulfate, peroxocarbonate, sodium and potassium perchlorate, oxides of chlorine and different intermediate compounds, formed during the process of spontaneous decomposition and reaction of above-mentioned substances.

Anode electro-chemical treatment also provides a little decrease of surface tension, increase of electroconductivity, increase of contents of dissolved chlorine and oxygen, drop of hydrogen and nitrogen concentration and change of water structure.

All above mentioned and many other agents can exist at one and the same time in cathode or anode electro-chemically treated water (in catholyte or anolyte respectively) because their concentration in water is relatively low. Spontaneous decomposition of chemical and physical (including structural) excitements in water, ballances the water. The values of the ballance are determined by existance of stable products of electrolysis.

There are three main factors which specify physical-chemical activity of anolyte and catholyte.

First - alkalis, acids and other stable products of electro-chemical reactions in catholyte and anolyte which replace traditional chemical additives, provide better results during utilization of catholyte and anolyte instead of usual water.

Second - high-active unstable products of electro-chemical reactions, life-time of which do not exceed several hours (free radicals, for example), considerably improve exposure of acid, oxidizing, alkali and reducing properties of anolyte and catholyte. As a rule it is impossible to produce them in water by

dissolving chemical reagents because of unique conditions of electro-chemical synthesis.

Third - existence of long-life dissipative structures, formed in the sphere of the space charge at the surface of electrode as free, as in the form of hydrate ion coatings, molecules, radicals, atoms, which impart catholyte and anolyte with the properties of catalizer of different chemical reactions, including bio-chemical, because it provides the change of activation energy barriers between reacting components.

Quasi-stable structural changes of water in electric field at the surface of electrode with field intensity up to millions of volts per  $\text{cm}^2$ , cause activation of water. In some cases, those changes are the main task of electro-chemical activation - for thin and exact processes in biology, medicine, microelectronics and pharmacology.

The effect of dissipative (activation) structure formation does not take place in industrial electrolyzers, because the conditions of electrolysis, as a rule, are very close to balance. This effect practically does not take place in the majority of known electrochemical devices, designed for treating of deluted water solutions. Dissipative structures, produced by destabilizing action of electric field on the fine laying of space charge at the surface of electrodes, are formed, in this case, at a distance, not exceeding  $5 - 6 \text{ \AA}$  under conditions of device stable operation, which means low grade of mass transfer in the laying of space charge. That is why, dissipative structures do not occupy more than 1% of catholyte or anolyte volume. The larger part of catholyte or anolyte volume

is occupied by catholyte or anolyte activation structures, produced in electrochemical devices, characterized by unstable operation, providing auto-oscillatory processes in membrane and solution cellular convection in the form of microvortex structures on the surface of electrode (dissipative structures of higher level, being the forms of space self-organization of electrochemical system). To achieve stability in operation of electrochemical device in such conditions is a very complicated scientific and technical problem, which can be solved with the aid of present invention.

It is impossible to determine exactly the action of each active catholyte and anolyte factor (stable, unstable products of electrochemical reactions and structural excitation), because in practice, improvement of alkali and reducing properties and weakening of acid and oxidizing properties in all reactions is the common characteristic of all three catholyte factors. Anolyte factors display opposite properties.

At the same time, it is possible to exclude completely the effect of any of these factors by changing operating conditions of technically perfect electrochemical device, in which dimensions and shape of electrode chambers correspond to typical dimensions of dissipative structures of high level (with additional charging from the zones of space charge), physical-chemical, physical-mechanic and filtration properties of membrane provide capacity to operate under auto-oscillatory conditions at the minimal diffusion and filtration transfer between electrode chambers, when hydraulic system ensures stabilization on the given level of pressure, concentration and volumetric solution supply to electrode chambers of the device.

This problem can be solved with the aid of the method and the device, described herein.

During the process of electrochemical treatment of water, containing sulfates, chlorides and carbonates, practically all possible reactions take place. But the current product output of these reactions may vary, providing product concentration from  $1 \cdot 10^{-14}$  to  $1 \cdot 10^{-2}$  moles per liter. Electrochemical activation process is performed at electricity charge specific consumption within the limits 200-300 and 2000-3000 coulombs per liter. It means, that concentration of electrochemical reaction products in catholyte or anolyte, will not exceed 0.03 - 0.05 moles per liter. In spite of thermodynamic barrier, high-active products of different electrochemical reactions can coexist for a long time in low mineralized water solutions (up to 10 g/l), fresh (less than 1 g/l) and distilled (but not less than 5 mg/l) water. Small concentrations of metastable substances affect considerably kinetics of their reaction, slowing down disintegration rate and providing phenomenon of long-life (for several hours) of abnormal reacting ability of catholyte and anolyte. Ability to strengthen the action of oxidizers and acids of different nature, and to weaken the action of reducers and bases in oxidizing-reducing and acid-basic reactions, is the common characteristic of anolyte in the period of abnormal activity (the period of relaxation). In the same manner catholyte strengthens the action of reducers and bases and weakens the action of oxidizers and acids. Both, catholyte and anolyte in the period of their abnormal reactive activity perform as active catalysts of fermentative, oxidizing-reducing and acid-basic cata-

lytic reactions, loosing catalytic activity after one-time chemical reaction.

It is possible to achieve selective suppression of oxidizing or reducing reactions of substance groups and acceleration of such reactions between other groups of substances, regulating the ion composition of parent solutions sequence and operating conditions of electrochemical treatment process. Besides, processes on electrodes, direction and consumption of the flow through the membrane are of great importance for the properties of electrochemically activated solutions.

In general, the flows, bearing substances through the membrane, are as follows:

a. Filtration flow. Its intensity is determined by membrane penetrability and pressure difference.

b. Diffusion flow. It depends upon the difference of solution concentration on both sides of membrane.

c. Electrodifffusion or migration flow. It is determined by current intensity.

d. Electroosmodic flow. It depends upon physical-chemical properties of membrane material and electric field current intensity in the membrane.

Material, of which electrodes and membrane are made, their physical-chemical properties, as well as device electrode unit designe (including shape and dimensions of electrode chambers), hydraulic cicuit and operating conditions affect the properties of catholyte and anolyte.

This invention provides effective control of anolyte and catholyte properties according to the demand.

The main object of this invention is to provide possibly minimal power consumption during the process of cathode or anode electrolytic treatment of low-mineralized water and achieve possibly maximum values of parameters, characterizing acid, alkali, oxidizing and reducing properties of water.

According to one aspect of this invention, the method of electrolytic treatment of water we claim, is characterized by water supply from bottom to the top of the device through cathode or anode working chamber of membrane electrolyzer in the clearance between electrode and membrane, with simultaneous flow of the water with higher mineralization grade through the auxiliary chamber, anode or cathode respectively, also from bottom to the top, in the clearance between the electrode and membrane, and electric current flow between cathode and anode through the water in both chambers and porous membrane, separating the chambers, in which case the pressure in working chamber exceeds the atmospheric pressure, and the water in auxiliary chamber is supplied upwards with the aid of gas bubbles, formed on the electrode, and returns back to auxiliary chamber from electrolyzer water outlet in which case first gas is separated and is taken off to atmosphere.

The second variant of the claimed method application is characterized by continuous partial change of water on the water outlet, arranged upstream of auxiliary chamber, during the process of electrochemical treatment and filling up the water to initial volume with the aid of its continuous filtration from working chamber through the membrane due to pressure difference, or - the third variant of method application, - the



water is filled up in auxiliary chamber with the aid of mineralized water supply to the water inlet of auxiliary chamber.

According to the other aspect of the present invention, a device, with the aid of which the above-mentioned method is to be performed, comprises membrane electrolyzer with flow-through cathode and anode electrode chambers, which have separated water inlets and outlets, while the auxiliary chamber forms a closed circuit with tank capacity arranged on the top of electrolyzer. Electrolyzer is designed in the form of at least one modular-type electrolytic element with coaxial arrangement of external tubular and internal core electrodes and tubular ceramic membrane, situated between electrodes, hermetically fixed with the aid of elastic packing rings and dielectric face-end bushings, which prolong the external cylindric surface of electrolytic element. Clearings between above-mentioned electrodes and membrane are equal. Ultrafiltration membrane is made of zirconium oxide.

The interval between electrodes, marked with letter "K" lays in the limits 2.5 and 3.5 mm, thickness of membrane shall not exceed 1 mm, diameter of core electrode shall be equal to 2.5 K, length of membrane working surface shall be (60...64)K.

In accordance with this invention, the method and the device for electrolytic treating water, has a wide range of application. For example, it may be used for water conversion into: detergents and bleaching means of all kinds, disinfectants for cattle-raising farms and hospitals, media for seed germination and malt production, active extragents for extraction of soluted components from vegetal and mineral resources, anti-

oxidant means and solutions for treating dermatosis, components of water-petrol emulsions providing their high stability, anti-rust media and many other useful solutions.

This invention will be explained by way of example with reference to some embodiments shown in the accompanying drawings in which: -

Fig.1 is a principle diagram showing the method of electrolytic treatment of water;

Fig.2 is a diagram of membrane electrolyzer designed in the form of modular-type electrolytic element.

The method of electrolytic treatment of water is performed with the aid of membrane electrolyzer I (Fig.1) with flow electrode chambers: working chamber 2 and auxiliary chamber 3.

Polarity of electrodes 4 and 5 in electrode chambers 2 and 3 of electrolyzer is not specified in Fig.1 because it shall be chosen in accordance with the demand. In case of anode treatment of water in the working chamber, electrode 4 is positive and electrode 5 is negative. In case of cathode treatment of water electrode 4 is negative and electrode 5 is positive. Water flows through working and auxiliary chambers along two flow paths, separated by ultrafiltration membrane 6 without mixing.

Water inlet (in the bottom part) and water outlet (in the top part) sockets of auxiliary electrode chamber are connected with the tank capacity 7, equipped with gas-separating valve, by flow paths, designed in the form of pipes. This forms a closed circuit. Gas-separating valve may be designed as a float 8 with a gate 9 and a muzzle 10, as one can see it in Fig.1.

Between auxiliary chamber water outlet pipe and tank capacity there is a suction socket (marked by hatching) for sucking in the water from auxiliary chamber. Between auxiliary chamber inlet pipe and tank capacity there is a socket for supply of mineralized water to auxiliary chamber (also marked by hatching).

Membrane electrolyzer I (Fig. I) is designed in the form of modular-type electrolytic element (Fig. 2) with coaxial arrangement of external tubular I and internal core 2 electrodes and tubular ceramic membrane 3, situated between them. Electrodes I and 2 and membrane 3 are fixed hermetically with the aid of elastic packing rings 4 and 5 and face-end dielectric bushings 6, which prolong external cylindric surface of electrolytic element. Inlets 7 and outlets 8 of electrode chambers are arranged on external cylindric surface of electrolytic element. Inlets and outlets are designed as holes in face-end bushings 6 and tubular electrode I near its ends, in the clearances between packing rings 9, arranged in grooves on external surface of electrolytic element.

Assembly and hermetization of electrolytic element is performed by tightening of bushings 6 to electrode I face-ends with the aid of nuts 10 and washers 11 on both outer ends of electrode 2.

Clearances between electrode I and membrane 3 and electrode 2 and membrane 3 are equal. The interval between electrodes I and 2, marked with letter "K", lays in the limits 2.5 and 3.5 mm, thickness of ultrafiltration membrane I, made of zirconium oxide, does not exceed 1 mm, diameter of internal core electrode is 2.5K.

and the length of membrane working surface is (60...64) K. The working surface of membrane lays between packing rings 4.

Electrodes 1 and 2 are made of titanium and are coated with platinum or platinum-iridium alloy.

The above-mentioned coatings resist to anode polarization, which provide easy change of working regime from cathode to anode water treatment with the aid of simple change of electrode polarity. In case anode is coated with ruthenium dioxide, manganese dioxide or magnetite, cathode is not coated at all and polarity of electrodes is not to be changed. Change of working regime from cathode to anode water treatment is performed in this case with the aid of hydraulic reconnections. Membrane electrolyzer power is set by parallel hydraulic connections of a desired number of electrolytic elements (inlets and outlets of cathode and anode chambers of one element to inlets and outlets of cathode and anode chambers of another element respectively). Electrolytic elements are arranged in collectors (omitted in drawings) and sealed off with the aid of packing rings 9 on external surface.

According to the basic principal of the present invention, the water flows upwards (Fig.I) through cathode or anode working chamber 2 of membrane electrolyzer I in the clearing between electrode 4 and membrane 6. Auxiliary chamber 3 and tank capacity 7 are filled with water of higher mineralization grade than the water in chamber 2. Electrochemical reactions on the surface of electrodes during the electric current flow between electrodes 4 and 5 result in gas-liberation process. Gas bubbles going upwards in chamber 3, raise the water, providing closed circulation

and gas offtake to tank capacity 7. The water does not soak from tank capacity 7 to chamber 2 through membrane, because pressure in chamber 2 is higher than atmospheric pressure. Tank capacity 7 and chamber 3 have an access to atmosphere through gas-separating valve, designed in the form of a float 8, a gate 9, arranged on the float, and gas muzzle 10.

In case the water level in tank capacity 7 rises, the float 8 rises too and gate 9 closes the muzzle 10. When gas is accumulated above the water surface in tank capacity 7, the water level drops. Float 8 goes down and excess gas is liberated through opened muzzle 10.

In case it is necessary to renew water in auxiliary chamber 3 circuit, part of the water shall be drained after it passes the outlet of auxiliary chamber. Drained water shall be renewed in circuit by its filtration from working chamber through membrane due to pressure difference or by supplying of mineralized water to the inlet of auxiliary chamber 3.

The effectiveness of the present method and the device in accordance with this invention has been proved by numerous experiments.

The method and the device, described herein, provide cathode electrochemical treatment of distilled water with electricity charge of 200-300 coulombs per liter, current intensity of 100 A/m<sup>2</sup> and voltage of 30 V without changing mineralization grade of water. In this case water oxidizing-reducing potential drops from +300 to -500 mV in the scale of platinum and silver-chloride electrodes. Solutions for chemical metallization of dielectrics, prepared on the basis of such water, permit to

produce non-porous, high-adhesive, oxidize-resistant coatings due to the different structure of precipitating metal. This water provides biostimulating and bioantioxidizing properties in different reactions, including those, with radioactive products. These results will not be achieved during water treatment with the aid of ordinary electrolyzers, which pretend to replace specialized ECHA devices.

WHAT WE CLAIM IS: -

I. A method of electrochemical treating water, characterised in that the water is supplied from bottom to the top of the device through cathode or anode working chamber of membrane electrolyzer in the clearance between electrode and membrane, with simultaneous flow of the water with higher mineralization grade through the auxiliary chamber, anode or cathode respectively, also from bottom to the top, in the clearance between the electrode and membrane, and electric current flow between anode and cathode through the water in both chambers and porous membrane, separating the chambers, in which case the pressure in working chamber exceeds the atmospheric pressure, and the water in auxiliary chamber is supplied upwards with the aid of gas bubbles, formed on the electrode, and returns back to auxiliary chamber from electrolyzer water outlet, in which case first, gas is separated and is taken off to atmosphere.

2. A method as claimed in Claim I, characterised in that the part of water is continuously drained on the water outlet, and is refilled to initial volume by its continuous filtration from working chamber through membrane due to pressure difference.

3. A method as claimed in Claim 1, characterised in that part of the water is continuously drained on the outlet of auxiliary chamber and is refilled to initial volume with the aid of supplying of mineralized water to the inlet of auxiliary chamber.

4. A device for electrochemical treating water, comprising membrane electrolyzer with flow cathode and anode electrode chambers, one of which is working and another is auxiliary, equipped with separated inlets and outlets, and that auxiliary chamber forms a closed circuit due to connection of inlet and outlet sockets to a tank capacity, which has gas-separating valve and is arranged on top of electrolyzer.

5. A device as claimed in Claim 4, characterised in that the membrane electrolyzer is designed in the form of at least one modular-type electrolytic element with coaxial arrangement of external tubular and internal core electrodes and tubular ceramic membrane, situated between them, all fixed hermetically with the aid of elastic packing rings and face-end dielectric bushings, forming the prolongation of external cylindric surface of electrolytic elements.

6. A device as claimed in Claims 4 and 5, characterised in that inlets and outlets of electrode chambers are arranged on external cylindric surface of electrolytic element and are designed in the form of holes in face-end dielectric bushings and tubular electrode near its ends, in clearings between packing rings, arranged in grooves on external surface of electrolytic element.

7. A device as claimed in Claims 4, 5 and 6, characterised

in that clearings between each electrode and membrane are equal and also in that the interval between electrodes, marked by letter "K", lays in the limits 2.5 and 3.5 mm, thickness of ultrafiltration membrane, made of zirconium oxide, does not exceed 1 mm, diameter of internal core electrode is 2.5 K and the length of membrane working surface is (60...64) K.



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**Patents Act 1977**  
**Examiner's report to the Comptroller under**  
**Section 17 (The Search Report)**

Application number 9105171.4

**Relevant Technical fields**

(i) UK Cl (Edition K) C7B (BCAB, BDAA, BDAD, BDVA, BDVB, BBU, BDXA)

(ii) Int Cl (Edition 5) C02F C25B

**Search Examiner**

M J INSLEY

**Databases (see over)**

(i) UK Patent Office

(ii)

Online Databases Used : Derwent W1;  
 Chemical Abstracts

**Date of Search**

07 JUNE 1991

Documents considered relevant following a search in respect of claims

1-7

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 1365496 (DOW CHEMICAL) see page 2 line 88 - page 3 line 15	1,4 at least
X	GB 1335941 (HOOKER) see page 5 line 75 - page 6 line 25 and figure 2	1,4 at least
X	EP 0023168 (CREUSOT-LOIRE) All Derwent Abstract No. 81-08212D/06	1,4 at least
X	US 4767511 (ARAGON) see figure 3 and column 7 line 45	1,4 at least
X	US 4212714 (GEC) see figure 1	1,4 at least
A	SU 1535637 (KAMSK TRUCK) see Derwent Abstract No. 90-230255/30	
A	SU 1274769 (MEAT IND. RES. INST) see Derwent Abstract No. 87-220098/31	

SF2(p)

GPAAAK

Category	Identity of document and relevant passages	Relevant to claim(s)

#### Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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